DOCUMENT RESUME

ED 304 341 SE 050 434

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TITLE Intellectual Development, Science Anxiety, and Content Achievement in Preservice Elementary Teachers.
PUB DATE 89
NOTE 13p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (62nd, San Francisco, CA, March 30-April 1, 1989).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Achievement; *Anxiety; Cognitive Ability; *Cognitive Development; Cognitive Structures; *College Science; Elementary Education; Elementary School Teachers; Formal Operations; Higher Education; *Preservice Teacher Education; *Process Education; Science Education; Teaching Methods

ABSTRACT

This study investigated preservice elementary teacher reasoning ability levels, science anxiety levels, and content achievement in a large midwestern university. Pretest and posttest measures were taken on three dependent variables: (1) reasoning ability (cognitive development); (2) science anxiety; and (3) science content achievement. In addition, relationships between reasoning ability, science anxiety, content achievement, microteaching experiences, and final grades were explored. A sample of 74 students enrolled in a science methods course for preservice elementary teachers participated in this study. There were significant differences, pretest-posttest, following 14 weeks of instruction in reasoning ability levels, science anxiety levels, and content achievement. The results of this study lend support to the notion that inquiry-oriented, hands-on, process-approach science activities which encourage social interaction may enhance formal reasoning skills. Furthermore, the evidence suggests science anxiety may be lessened and content achievement increased during these kinds of activities. These findings may be of particular interest to science educators since primary educational goals leading to more effective elementary science teaching include an increase in student reasoning ability and a decrease in science anxiety. (Author/CW)

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INTELLECTUAL DEVELOPMENT, SCIENCE ANXIETY, AND CONTENT ACHIEVEMENT IN PRESERVICE ELEMENTARY TEACHERS

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Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, CA, April, 1989.

SE 050 434

INTELLECTUAL DEVELOPMENT, SCIENCE ANXIETY, AND CONTENT ACHIEVEMENT IN PRESERVICE ELEMENTARY TEACHERS

Abstract

This study investigated preservice elementary teacher reasoning ability levels, science anxiety levels, and content achievement in a large midwestern university. Pretest and posttest measures were taken on three dependent variables: (1) reasoning ability (cognitive development), (2) science anxiety, and (3) science content achievement. In addition, relationships between reasoning ability, science anxiety, content achievement, microteaching experiences, and final grades were explored. A sample of 74 students enrolled in a science methods course for preservice elementary teachers participated in this study.

There were significant differences, pretest-posttest, following 14 weeks of instruction in (1) reasoning ability levels ($p<.01$), (2) science anxiety levels ($p<.001$), and (3) content achievement ($p<.001$). Science anxiety, content achievement, and final grades correlated moderately with reasoning ability. There was no significant correlation between science anxiety, content achievement, and reasoning ability with peer microteaching scores. However, final grade correlated moderately with peer microteaching scores.

The results of this study lend support to the notion that inquiry-oriented, hands-on, process-approach science activities which encourage social interaction may enhance formal reasoning skills. Furthermore, the evidence suggests science anxiety may be lessened and content achievement increased during these kinds of activities. These findings

may be of particular interest to science educators since primary educational goals leading to more effective elementary science teaching include an increase in student reasoning ability and a decrease in science anxiety.

INTELLECTUAL DEVELOPMENT, SCIENCE ANXIETY, AND CONTENT ACHIEVEMENT IN PRESERVICE ELEMENTARY TEACHERS

Purpose

The purpose of this study was to investigate preservice elementary teacher reasoning ability levels, science anxiety levels, and content achievement in a large midwestern university. A recent study by Tobin and Garnett (1984) generated evidence to support the notion that a significant number of preservice elementary teachers in Western Australia do not use formal reasoning skills. As such, these students may not possess reasoning skills and content knowledge necessary to plan and to implement an effective activity-oriented inquiry science program. Numerous investigators support the findings of Tobin and Garnett in that high percentages of adolescents and young adults fail to use formal reasoning (summarized by Chiappetta, 1976). Given that a primary educational goal is to teach students to become better thinkers, strategies that promote reasoning ability should be explored and implemented. Results from several studies suggest that inquiry-oriented instruction using concrete materials in socially interactive settings may promote formal reasoning skills (Karplus, 1977; Lawson, Nordland, & DeVito, 1975; Renner & Lawson, 1975). In addition, Lawson (1982) presented evidence that suggested formal reasoning instruction can be successful and should be encouraged even after the normal developmental period of ages 12-18.

Reduction of science anxiety among preservice and inservice elementary teacners remains another important goal in science education. Anxiety is an emotion experienced frequently by students in science

classes, particularly in elementary science methods classes. Furthermore, anxiety is an emotion shown to impede achievement.

In the research described in this paper, preservice elementary teacher reasoning ability was measured using the Group Assessment of Logical Thinking (GALT) test (Roadrangka, Yeany, & Padilla, 1983). Science anxiety was determined using the Science Anxiety Scale (SAS) developed and validated by Fraser, Nash, and Fisher (1983). Content achievement was assessed using test items from the Elementary Science Department, Utah State University.

It was hypothesized that subjects participating in a semester-long science methods course which emphasized interactive, hands-on activities based on the learning cycle approach would demonstrate an increase in formal reasoning skills and science content achievement and a decrease in science anxiety.

Design and Procedures

This study was conducted during the 1988 spring semester using 74 subjects enrolled in a preservice elementary science methods course at a large midwestern university. Dependent variables were scores on: (1) a 49-item science content text, pretest-posttest; (2) a 12-item Group Assessment of Logical Thinking, pretest-posttest; and (3) a 21-item Science Anxiety Scale, pretest-posttest. Pretests were administered at the beginning of the semester and the same tests were administered as posttests after 14 weeks of instruction. In addition, relationships between reasoning ability, science anxiety, content achievement, microteaching experience, and final grades were explored.

All subjects participated in three peer microteaching experiences in which each student planned, prepared, and presented elementary science lessons based on inquiry-oriented, hands-on, process-approach activities which encouraged social interaction. In addition, subjects presented on-site science lessons in small groups in local elementary schools. Students were encouraged to present all lessons based on the learning cycle approach (Karplus, 1977).

Results

The mean pretest score on the formal reasoning test was 7.23 out of 12 possible (SD = 2.57). The mean posttest score was 8.08 (SD = 2.45). This difference was statistically significant, $t = -3.17$, $p<.01$.

The mean pretest score on the science anxiety scale was 12.31 out of 21 possible (SD = 3.27). The mean posttest score was 9.97 (SD = 3.30). This difference was statistically significant, $t = 5.63$, $p<.001$.

The mean pretest score on the science content test was 21.34 out of 49 possible (SD = 5.21). The mean posttest score was 28.66 (SD = 5.37). This difference was statistically significant, $t = -12.88$, $p<.001$.

Science anxiety, content achievement and final grades correlated moderately with reasoning ability. Each relationship was significant at $p<.05$ or better. There was no signficant correlation between science anxiety, content achievement, and reasoning ability with peer microteachng scores. However, final grade correlated moderately with peer microteaching scores ($p<.001$).

Discussion

It is of particular interest to hypothesize as to the significant increase in subjects' reasoning ability levels and the significant

decrease in their science anxiety levels following 14 weeks of instruction. Perhaps the repeated peer microteaching experiences in which students interacted in small group settings using relatively simplistic concrete materials helped reduce science anxiety. In addition, the microteaching lessons placed emphasis on the learning cycle approach in which students first actively explored and manipulated concrete materials in small groups using science process skills prior to concept introduction and application. These activities provided opportunities for social interaction and sequenced concrete experiences, each of which is necessary to enhance cognitive development for students with lower reasoning abilities (Lawson & Snitgen, 1982).

Conclusions

1. This study generated evidence to support the idea that inquiry-oriented, hands-on, process-approach science activities which encourage social interaction during peer microteaching may enhance formal reasoning skills in preservice elementary teachers. These results support the work of Karplus (1977), and Lawson (1980) in that inquiry-oriented, hands-on, sequenced instruction may be used as a strategy to promote formal reasoning ability.

2. Significant reduction in science anxiety among preservice elementary teachers following 14 weeks of instruction lends support to the hypothesis that repeated peer microteachings using simplistic materials in an interactive social setting decreases student science anxiety.

3. There was significant increase in science content learned by preservice elementary teachers.

4. There was significant correlation between reasoning ability and (1) content achievement, (2) final grades, and (3) science anxiety. Final grade correlated significantly with peer microteaching scores. There was no significant correlation between microteaching scores and (1) content achievement, (2) science anxiety, and (3) reasoning ability.

Literature Cited

Chiappetta, E.L. (1976). A review of Piagetian studies relevant to science instruction at the secondary and college level. Science Education, 60, 253-261.

Fraser, B.J., Nash, R., & Fisher, D.L. (1983). Anxiety in science classrooms: Its measurement and relationship to classroom environment. Research in Science and Technological Education, 2, 201-207.

Karplus, R. (1977). Science teaching and the development of reasoning. Journal of Research in Science Teaching, 14, 169-175.

Lawson, A.E. (1980). Relationships among level of intellectual development, cognitive style, and grades in a college biology course. Science Education, 64, 95-102.

Lawson, A.E. (1982). The relative responsiveness of concrete operational seventh grade and college students to science instruction. Journal of Research in Science Teaching, 19, 63-77.

Lawson, A.E., Nordland, F.H., & DeVito, A. (1975). Relationship of formal reasoning to achievement, aptitudes, and attitudes in preservice teachers. Journal of Research in Science Teaching, 12, 423-431.

Lawson, A. E., & Snitgen, D. A. (1982). Teaching formal reasoning in a college biology course for preservice teachers. Journal of Research in Science Teaching, 19, 233-248.

Renner, J.W., & Lawson, A.E. (1975). Intellectual development in preservice elementary school teachers: An evauation. Journal of College Science Teaching, 5, 89-92.

Roadrangka, V., Yeany, R.H., & Padilla, M.J. (1983, April). The construction and validation of group assessment of logical thinking (GALT). Paper presented at the annual meeting of the National Association for Research in Science Teaching, Dallas, TX.

Tobin, K.G., & Garnett, P.J. (1984). Reasoning ability of preservice primary teachers: Implications for science teaching. The Australian Journal of Education, 28, 89-98.

Comparison of Pretest and Posttest Scores on Reasoning Ability, Science Anxiety, and Content Achievement Among Preservice Elementary Teachers

Variable	Pretest $\bar{x}$	Pretest SD	Posttest $\bar{x}$	Posttest SD	t-value
Reasoning Ability	7.23	2.57	8.08	2.45	-3.17*
Science Anxiety	12.31	3.27	9.97	3.30	5.63**
Content Achievement	21.34	5.21	28.66	5.37	-12.88**

*$p < .01$
**$p < .001$

Pearson Product Moment Correlation Coefficients Among Performance Variables for Preservice Elementary Teachers

	Micro-Teaching 1	Micro-Teaching 2	Micro-Teaching 3	Content 1	Content 2	Final Grade	Science Anxiety 1	Science Anxiety 2	Reasoning Ability 1	Reasoning Ability 2
Microteaching 1	1.00									
Microteaching 2	.28**	1.00								
Microteaching 3	.39***	.55***	1.00							
Content 1	-.01	.03	.06	1.00						
Content 2	.11	.12	.19	.57***	1.00					
Final Grade	.45***	.52***	.60***	.40***	.57***	1.00				
Science Anxiety 1	-.04	-.01	.08	-.42***	-.42***	-.27**	1.00			
Science Anxiety 2	-.11	-.17	-.12	-.42***	-.49***	-.45***	.48***	1.00		
Reasoning Ability 1	-.01	.06	-.01	.51***	.47***	.43***	-.31**	-.40***	1.00	
Reasoning Ability 2	-.10	.12	-.03	.30**	.44***	.42***	-.25*	-.25*	.58***	1.00

*$p<.05$
**$p<.01$
***$p<.001$